

# THE SSC XID DATABASE

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## ABSTRACT

The XMM identification (XID) programme is accumulating Optical/IR data to identify thousands of XMM sources at both high ( $b|l| > 20^\circ$ ) and low galactic latitude. X-ray sources are divided into samples on the basis of their X-ray flux and their Galactic latitude. The XID Programme aims to identify and classify around 1000 object in each sample. These in turn, will be used to provide a basis for the statistical identification of the much larger pool of serendipitous objects observed in XMM fields. The purpose of the XID database is to underpin these projects by storing and connecting key information from XMM XID fields and sources, together with (primarily) Optical/IR multi-colour imaging and spectral data from the ground-based follow-up campaign. It should shortly be able to serve as both a support tool for guiding the ‘ground-based’ effort, and permit collation and scientific exploitation of the results.

Key words: Missions: XMM-Newton, Databases

## 1. INTRODUCTION

The large collecting area and sensitivity of XMM to hard X-ray ( $E > 2$  keV) will give access to a large number of especially faint galactic and extra-galactic X-ray emitting objects. Each Full Frame mode EPIC field adds tens of new objects to the list of serendipitous XMM survey sources. Multi-wavelength information can substantially increase our knowledge of individual systems while also providing a means for probing broader cosmological issues. The XID-Database is designed, and is being implemented, to be the central engine for data management and data-mining of the ensemble of X-ray and Optical/IR data relevant to the identification project [Watson et al. 2001]. It is intended to support observers in the preparation of the follow-up Optical/IR observations by providing access to key data and an overview of the status of the programme at any instant. It will also become a tool for pursuing scientific analysis of the accumulated data. An essential function of the database is to accommodate a range of XMM-Newton and Optical/IR ground-based data and to provide the relevant links between related observations and objects. It correlates lists of X-ray and ‘op-

tical’ objects and isolates potential optical counterparts to the X-ray sources. These can then be pursued with ground-based spectroscopy for final identification.

## 2. DATA STRUCTURE AND CONTENT

The heterogeneity of the data in the XID-Database makes its design and maintenance complicated. An Object Oriented data structure is consequently the best solution for organizing the data and making links between them without requiring too many repetitions of references and identifiers in various tables, as would be the case in a relational database. We use the O2 database engine which is intrinsically Object Oriented. Figure 1 shows the main content of the database and relation between various type of data.

### 2.1. XMM DATA

XMM-Newton fields are the corner stone of the XID programme and therefore form the top level objects of the database. XMM observations are attached to fields via the coordinates and proposal ID. A unique list of X-X correlated sources is constructed for each field from all the observations related to it. The database ingests all available information from images and source lists of the X-ray observations. Moreover, it assigns sources either to a low Galactic latitude sample, or to high latitude Faint, Medium or Bright samples based on their X-ray flux in XID-band (0.5-4.5 keV). As further products, such as spectra, time-series and extension details become available, these too will be ingested.

### 2.2. XID-OPTICAL DATA

For the XID-optical data the situation is more complicated because the optical information comes from a number of different observatories and processing institutes. Furthermore, the optical imaging observations can be associated with multiple XMM fields. Optical object lists from multiple filter images are correlated (O-O correlation) to yield a list of unique optical objects whose original data remains accessible. The correlated list must be updatable since observations in different filters may not be obtained, or be ingested, at a single epoch.

### 2.3. X-RAY /OPTICAL CORRELATION AND IDENTIFICATION

### REFERENCES

From the unique lists of X-ray and optical sources, a further correlation is made to isolate a list of potential optical counterparts for each X-ray source and a finding chart should be created. Follow-up spectroscopy (slit or multi-fibre) of counterparts can then be ingested and classification and other details of any identifications incorporated. With these fundamental data components, the database creates a complex set of internal links and pointers which connect together a wide range of observational and source parameters. Figure 2 illustrates a typical identification procedure.

- Watson M.G., et al, 2001, A&A, 365, L51.  
 Barcons X. et al., astro-ph/0110269, to appear in A&A.  
 Barcons X. et al., in this Proceedings.  
 Della Ceca R. et al, in this Proceedings.

### 2.4. OTHER DATA

The correlation of the XMM objects with the GSC and Rosat Bright Source catalogue will be soon available. The database also contains auxiliary information such as the list of XID-Optical programme runs which, along with other available data from the database, is intended to provide XID observers with an overview of the observational status of the programme.

## 3. SCIENTIFIC APPLICATION OF THE XID-DATABASE

The first potential scientific application of the XID Database could be the AXIS project though due to delays in the implementation of the database, it has not yet been able to exploit it. Nonetheless, all the data which have been acquired for the project are being ingested into the XID-Database. These data have led to the identification of 29 XMM high galactic latitude, medium sample sources [Barcons et al. 2001, Barcons et al. 2002]. A similar study for the Bright Sample is performed by ???. A major aim of the XID-Database is to facilitate the extension of this study to a much larger collection of X-ray sources. When a significant number of sources are identified, the multi-wavelength properties will be used to statistically classify the large body of serendipitous XMM-Newton sources, for which the acquisition of discriminating spectra would be prohibitive. In the longer term, the XID database can be a powerful tool for a range of data-mining activities e.g exploiting properties of classes of objects, verification of theoretical models, large scale correlation of extra-galactic objects and their evolution in cosmological time, etc, as well as being a gateway to the study of previously unknown, individual objects.

## 4. DATA ACCESS

Once the database is significantly populated and verified, and identification information is integrated, it will become an important scientific repository and will be opened to the SSC community through a web interface.

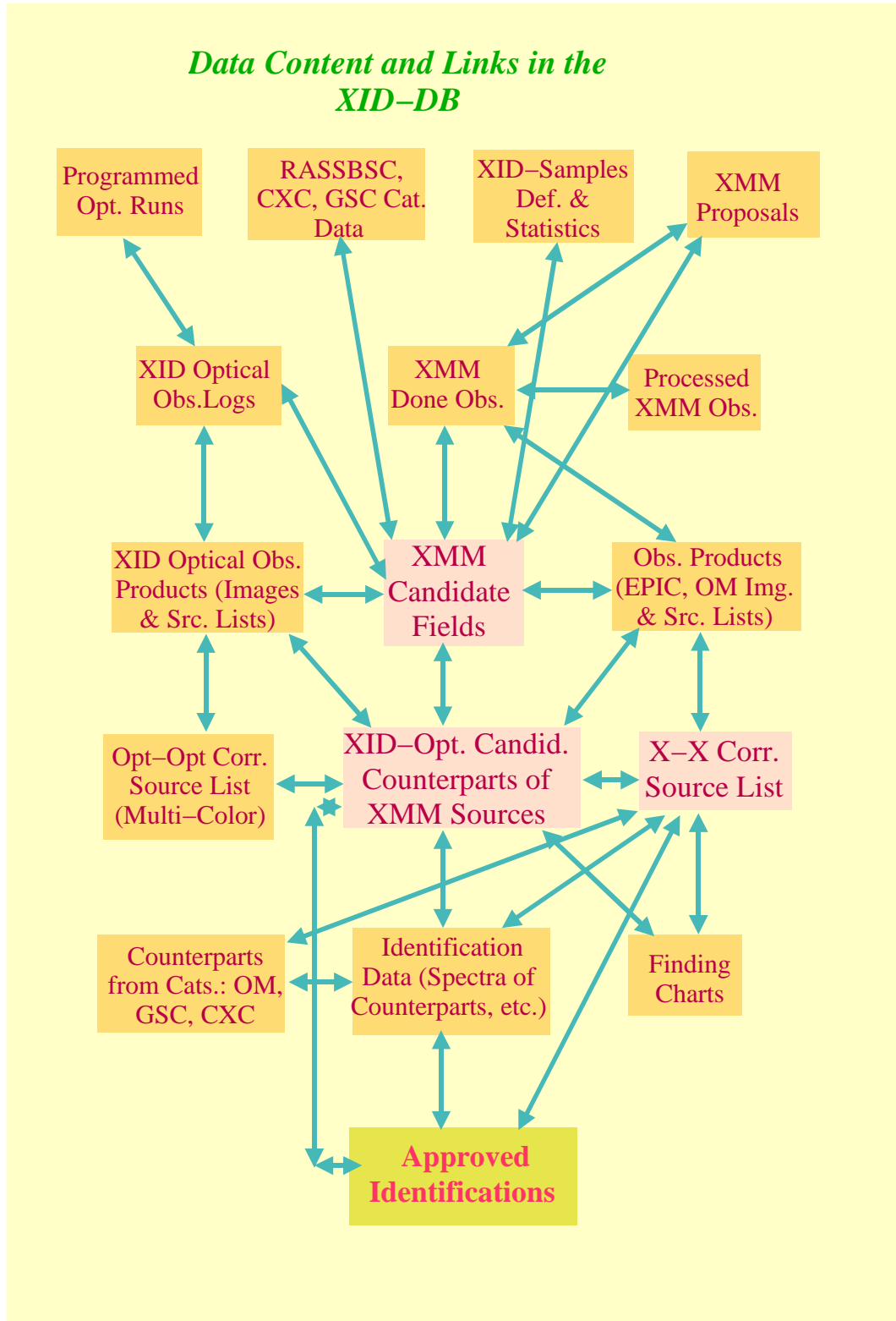


Figure 1. Flow diagram of the XID-DB data and their links.

*Figure 2. Illustration of the data products stored in the XID-Database and the logical astronomical links between them: a) On an XMM-XID band image one of the sources is selected; b) The XID-Optical finding chart of the X-ray source. Potential optical counterparts are selected based on their distance on the sky from the X-ray source. c) The spectrum of the closest optical counterpart which has been tentatively identified as an AGN type I at  $z = 0.679$ .*

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